MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. LXXXII. CENTENARY CELEBRATION, 1922.

ROYAL ASTRONOMICAL SOCIETY CENTENARY CELEBRATION.

The Celebration opened with a Conversazione on May 29, at 8.30 p.m., held by kind permission in the apartments of the Royal Society.

Professor A. S. Eddington, supported by his sister and by the other Officers of the Society with their wives, received the guests, who numbered over 300. Academic dress was worn. The following objects of interest were exhibited in the library:

Photographs and Transparencies	Dr. STEAVENSON.
Aids to Calculation, Ancient and Modern	Mr. F. ROBBINS.
Historical Instruments	Mr. D. BAXANDALL.
Ancient Books	Mr. W. A. PARR.
The Probability Curve	Prof. PLUMMER.
The Newton Relics	*lent by the* ROYAL SOCIETY.
Portrait of Galileo	*lent by* Mr. G. H. GABB.
Babbage's Logarithm Tables	*lent by* Prof. SAMPSON.

The thanks of the Society are due to the above exhibitors.

The following short lectures, illustrated by lantern slides, were delivered in the Meeting Room:

Sunspots, 1820–1920	Mr. MAUNDER.
Mars and Jupiter, 1820–1920	Rev. T. E. R. PHILLIPS.
The Comets of the Century	Dr. CROMMELIN.
Some Fellows of the Society	Mr. HOLLIS.
Instruments of the Period	Mr. HEPBURN.

The Morning Meeting on May 30 opened at 11 o'clock. The President, Professor Eddington, in the Chair. He read the following loyal

message which had been sent to His Majesty King George V., Patron of the Society:

"MAY IT PLEASE YOUR MAJESTY!

"We, the Fellows of the Royal Astronomical Society, assembled to celebrate the Centenary of our foundation, desire to send a message of homage and loyalty to Your Majesty our Gracious Patron.

"We look back on a wonderful century of astronomical discovery, and we take pride in the contribution made by the Fellows of our Society, both to pure scientific knowledge, so essential to the progress of mankind, and to the valuable applications of astronomy in navigation and in the survey of the earth.

"From the far corners of the Empire we are banded together to keep a zealous watch on the skies, and to penetrate, as far as human limitations permit, the mysteries of the Universe.

"We look forward to maintaining and extending these activities in the future under Your Majesty's continued encouragement and patronage."

The President also read the following gracious reply, transmitted by Lord Stamfordham:

"I am commanded by the King to thank you and the Fellows of the Royal Astronomical Society for your loyal message on the occasion of the Centenary of its foundation.

"During the last hundred years the civilised world has witnessed a wonderful advancement in astronomical discovery, and His Majesty is proud to know that the Royal Astronomical Society, both here and in the far corners of the Empire, has given its full measure of support towards the success of these valuable achievements.

"You can rest assured that the King watches with interest and admiration the patient, diligent, and unobtrusive manner in which the Fellows of the Society conduct their unremitting research, in the hope that they may, by piercing the hidden mysteries of the skies, add step by step to the store of scientific knowledge and thus contribute so much that is essential to the progress of mankind on land and sea.

"STAMFORDHAM."

1922 *May* 29.

Congratulatory telegrams and messages were received from the following:—

Monsieur Baillaud, Professor Barnard, Professor Kapteyn, Dr. Max Wolf, Professor Donner, Monsieur Puiseux, Professor Küstner, Professor Wolfer, Professor Perrine; Mount Wilson Observatory, The Dutch Astronomical Society, The Russian Astronomical Society, The Danish Astronomical Society, The American Astronomical Society, Christiania Observatory, and the Astronomische Gesellschaft. A letter was also read from the Assistant Secretary, who was prevented by illness from attending the Meetings.

The President then delivered the following address on the history of astronomy during the century:

The celebration of a centenary is an occasion for retrospect over the past and for hopeful outlook towards the future. At our meeting this

morning the events and personalities of the *past* will occupy our thoughts; this afternoon the *present* activities of astronomy will be brought before us by those who have come to us from overseas; and when, finally, at our dinner this evening, we raise our glasses to the health and prosperity of the Royal Astronomical Society, we shall look forward with hope and confidence to that part of our history which is yet hidden in the *future*.

It needs a historian to deal with a matter of history, and I am fortunate in being able to leave to Dr. Dreyer the task of bringing before us the history of our Society during these hundred years. He will, I hope, give us a foretaste of what has been collected by himself and other collaborators for the Centenary Volume which is to be published later this year. My own opening remarks will touch somewhat desultorily on the general features of the growth of astronomy during this period.

I wonder whether there would be substantial agreement among us as to which are the outstanding landmarks in these hundred years. We have here representatives of many different sides of astronomy, who view it from many different aspects, and I should not be surprised if there are wide differences of opinion. Like selecting the hundred best books, the selection of, let us say, the six great landmarks of astronomical progress in the century is a pastime which need not be taken too seriously. I shall venture to try my hand at a selection:—

(1) 1839. The first determinations of stellar parallax of 61 Cygni and α Centauri, giving for the first time a definite idea of the scale of the stellar universe.

(2) 1846. The discovery of Neptune. An event perhaps more highly celebrated outside astronomical circles than among professional astronomers, but producing an incalculable moral effect.

(3) 1864–68. The early spectroscopic discoveries of Huggins and Lockyer, and the rise of spectroscopic astronomy.

(4) 1882–1887. The beginnings of stellar photography, starting with Gill's photograph of the great comet of 1882, and leading to the inception of the Astrographic Chart in 1887.

(5) 1904. Kapteyn's discovery of the two star-streams, the beginning of the modern era of investigations of the sidereal system.

Coming to events so near to the present that we cannot yet put much trust in our perspective, I would very tentatively include—

(6) 1920. The measurement of the angular diameter of Betelgeuse by Michelson's interferometer method.

I would not venture to predict how great or how immediate may be the influence of this last on the progress of astronomy, but it seems to me to be worthy of a place in this select list as a triumph of scientific achievement which is second to none. It is one of those signal instances which convince us that the word "impossible" must be banished from the vocabulary.

This is a record of continuous advance—not in great waves followed by periods of exhaustion. A new impetus has always been found before the last one has begun to fail. Even the allied science of physics has not, I think, had such a continuous record. I am told that there was a period shortly before X-rays and electrons came to the fore, when the

physicist had given up anticipating any radical advance; he thought that the big discoveries were already garnered; and the feeling, so present with us to-day, that we are on the verge of something greater than our dreams can shape, had not yet disturbed his placid progress.

The centre of most rapid progress has shifted from time to time; and the various branches of astronomy have had their ups and downs. I suppose that in recent years the department of planetary astronomy has been in the depression of a wave. At least it seems to be so in comparison with the more sensational progress in our knowledge of the sun and stars. Whether we regard the physical observation of the surfaces of the planets, or the study of their motions, the openings for advance seem to be few and difficult. But the depression has by no means reached stagnation. We have the remarkable advance in planetary photography, exhibited at several recent meetings of the Society; the discovery of new satellites, including Jupiter's two pairs of twins, and the specially significant phenomenon of the retrograde motion of the outermost satellites of Jupiter and Saturn; the determination of the rotation period of Uranus by Slipher; and the Trojan group of minor planets, whose principal merit is that they have beneficently prevented the once great science of dynamical astronomy from growing altogether rusty. Renewed interest is added to the exact and regular observation of the positions of planets by Einstein's explanation of the anomalous motion of Mercury; the same observations reveal interesting irregularities in the longitudes of the planets which perhaps reflect inequalities in the rotation of the earth as standard time-keeper. These observations, which else might have seemed to be mere survivals of traditional routine, are seen to be full of importance for the future; and for the same reason we welcome the revival of observations of occultations of stars by planets. On the theoretical side we have Taylor's important investigation of tidal friction in the Irish Sea, which, true to its name, is responsible for a considerable proportion of the friction and dissipation of energy on this planet; and Jeans's researches have given us new ideas of the origin of the planets which attend the sun, and of the singular (perhaps even unique) character of this system. Many other researches in this field could be mentioned. If the department of planetary astronomy is now the Cinderella of our science, she yet has dreams that her Prince is waiting for her.

It is startling to-day to read a passage from Huxley's Essays which runs, "Until human life is longer and the duties of the present press less heavily, I do not think wise men will occupy themselves with Jovian or Martian natural history." Martian and—I almost fear to mention it—lunar natural history are, no doubt, thorny subjects, but, notwithstanding Huxley's censure, probably the most sceptical among us would admit that the observation of seasonal changes of what is presumably some kind of vegetation on Mars is a recognised astronomical pursuit.

In reviewing the general advance of astronomy during the century, we cannot but be struck by what I may call its *centrifugal* tendency—the tendency to leave the little system ruled by the sun and penetrate

deeper and ever deeper into the vast world outside. In the older books the author leads us deliberately through the planets one by one, and it is with difficulty that the account of the stellar universe can be spun out to any respectable length. Before the first meeting of this Society in 1820 an introductory address was circulated, which contains the paragraph:—

"Beyond the limits of our own system all at present is obscurity. Some vast and general views on the construction of the heavens, and the laws which may regulate the formation and motions of sidereal systems, have, it is true, been struck out; but, like the theories of the earth which have so long occupied the speculations of geologists, they remain to be supported or confuted by the slow accumulation of a mass of facts; and it is here, as in the science just alluded to, that the advantages of associated labour will appear more eminently conspicuous."

Whilst much obscurity still remains, this vast territory has been definitely annexed and occupied. From the planetary system we have passed to the stellar system; and I am not sure if even the study of that great aggregation of stars, which we used to think was the whole universe, is not becoming a little old-fashioned, and the really up-to-date young astronomer would refuse to bother about anything nearer than a globular cluster. At least it is one of the most startling features of recent research that so much exact knowledge has been obtained of the conditions of stars in globular clusters, not one of which is nearer than 10,000 light years—knowledge which in many respects far surpasses in precision that which it has been possible to obtain for the much nearer denizens of our own star-cloud.

It may be of interest to examine how this centrifugal tendency is reflected in our *Monthly Notices*, and I have prepared a slide to show how the subject-matter of the papers has changed. The figures claim no great accuracy, because it is often difficult to classify the papers clearly and uniformly. And, of course, the statistics do not distinguish important papers or long-continued observations from trivial notes and controversies. But on the whole the figures seem to be truly representative.

Classification of Papers in Monthly Notices.

	1840. (3 years).	1860.	1880.	1900.	1919.	1920.
Instrumental	6	4	11	3	6	5
Solar system	39	69	73	56	14	21
Stellar universe	18	13	22	21	49	40
Geodesy, navigation, seismology, etc.	14	3	6	...	5	11
Ancient observations	2	1	1	...	1	1
Mathematical (not classed above)	...	...	2	...	1	12
Ditto, omitting ephemerides, tabular observations, and formal reports of phenomena.						
Solar system	9	38	34	21	11	17
Stellar universe	7	11	16	12	33	32

It appears that the serious change did not begin until after 1900. Although it shows itself quite suddenly in the statistics, it had been steadily prepared for during a long period. It must be remembered that much of the heaviest work on the stars is by its nature excluded from the *Monthly Notices*, and appears only in the more voluminous publications of observatories. Solar, lunar, and planetary observations are not usually too bulky to include. Much long-continued preparation for proper motions, spectral classification, radial velocities, stellar magnitudes, etc., began to come to fruition between 1900 and 1910. But I think the great impetus to sidereal astronomy came from Kapteyn's discovery, which I have mentioned among the six landmarks of the century. The two star-streams were the first taste of the many amazing results contained in the statistics collected or being collected. They were the first indication to us of something like organisation among the myriads of stars. Paradoxical as it may seem, the duality of the stellar system was the first clear indication to us of its unity. In the earlier years most of the papers classified in the table as referring to the stellar universe dealt with particular objects—variables, rapid binaries, novæ. It was a period of individualism. But from 1900 onwards the great democracy of the stars was brought into prominence, and a great wave of stellar socialism began. Kapteyn is the typical pioneer of a numerous body of investigators, who view the heavens in the spirit of Xavier le Maistre in *Voyages autour de ma Chambre*:—

"The most brilliant stars have never been those which I contemplate with most pleasure; but the tiniest ones, those which, lost in immeasurable distance, appear only as barely perceptible points, have always been my favourite stars."

Yet perhaps in the very latest years there has been a reaction towards individualism. The statistical mill is no longer working overtime. The queer stars, such as Cepheids, runaway dwarfs, special binaries, are beginning to contribute more largely to the general perfection of the whole scheme. Strange objects, which persist in showing a type of spectrum entirely out of keeping with their luminosity, may ultimately teach us more than a host which radiate according to rule.

You may have noticed that in the earliest years the disproportionate excess of papers on the solar system compared with the outside regions of the universe was not so marked as it afterwards became. This is no accident. The founders of the Royal Astronomical Society, whilst confessing almost complete ignorance of this domain, were resolved that it should be attacked and had the conviction that patient research would make the advance possible. Indeed, it was just this which was placed among the most prominent reasons for banding together. With regard to eclipses, planets, and comets it might be possible to struggle along individually; but the problems involving thousands of stars were too vast for one man or for one generation. They saw that the observations were being piled up, but without uniformity and without system. To quote again from their address:—

"One of the first great steps towards an accurate knowledge of the construction of the heavens is an acquaintance with the individual objects which they present: in other words, the formation of a complete

catalogue of stars and of other bodies, upon a scale infinitely more vast than has yet been undertaken, and that shall comprehend the most minute objects visible in good astronomical telescopes. To form such a catalogue, however, is an undertaking of such overwhelming labour as to defy the utmost exertions of individual industry. It is a task which, to be accomplished, *must* be divided among members; but so divided as to preserve a perfect unity of design. . . . The intended foundation of an observatory at the southern extremity of Africa, under the auspices of the Admiralty, may serve to show the general sense entertained of the importance of this subject, and the necessity of giving every possible perfection to our catalogue of the fixed stars. Deeply impressed also with the importance of this task, and fully aware of its difficulty, the Astronomical Society might call upon the observers of Europe and of the world to lend their aid in its prosecution. Should similar institutions be formed in other countries, the Astronomical Society (rejecting all views but that of benefiting science) would be ready and desirous to divide at once the labour and the glory of this Herculean attempt, and to act in concert together in such manner as should be judged most conducive to the end in view."

It is largely the Herculean nature of the task before us which has led to astronomy being to-day (whether for good or ill) the most highly organised of the sciences.

The accomplishment of these objects has not been rapid. There is a passage in the First Annual Report of the Council which may interest the Chairman of the Commission on Stellar Photometry, whom we are glad to have with us. It mentions as one of the greatest desiderata a means of determining the apparent magnitudes of the stars, and the ascertaining of "a correct scale whereby astronomers may be enabled to express themselves in one common language on this subject." I think Professor Seares would say that the lapse of a century has not quite sufficed for the completion of this uniform scale; but the main difficulties have been surmounted, and the time is very near now when all astronomers will be able to express themselves in a common language in regard to stellar magnitudes, both visual and photographic.

We celebrate to-day our centenary, and by a simple subtraction sum, subtracting 100 years from 1922 May 30, you arrive at the date of our foundation 1820 January 12, according to the most accredited calculations—which I trust no mathematician here will venture to criticise. The great event caused a ripple in the æther, which has spread out ever since in widening circles. To-day that ripple embraces about 5000 of the fixed stars. The remaining thousand million or so are still outside. Though a good many of the best-known stars must by this time have received the tidings, 90 per cent. of the naked-eye stars are still in ignorance. We should like to think that the stars of the morning sing together with joy on this our centenary; but the cold truth must be faced that not 1 in 100,000 can yet have heard of our birth. But we shall look out on the heavens again to-night with renewed enthusiasm and joy; and, if from the majority of the stars we can expect no more than an unrecognising stare, there are half a dozen old favourites which —we may fairly be persuaded—will give us an answering twinkle.

Dr. Dreyer then gave an address on the history of the Society. (He does not consider it necessary to print this, as the substance of it is contained in the forthcoming volume on the history of the R.A.S.). A few points are mentioned here. The state of mathematics in England a century ago was behindhand as compared with that on the Continent. This was ascribed in part to the survival of the clumsy fluxional notation, which had come down from the time of Newton. The failure of the effort to obtain solutions of certain problems by offering prizes was mentioned. One of these was offered for a theory of Saturn's satellite system. Dr. Dreyer noted that eighty years later Dr. Hermann Struve received the Gold Medal of the Society for his work in this field. The Society's efforts to improve the *Nautical Almanac* resulted in the appearance of the greatly extended almanac in 1834; Encke had received the Gold Medal a few years earlier for his improved Berliner Jahrbuch.

The President and five other Fellows of the Society were given places on the Board of Visitors of the Royal Observatory, Greenwich. They helped to decide in the affirmative the question of the continuance of the observatories at the Cape and at Paramatta, and they successfully recommended the appointment of Henderson as Director at the Cape.

Attention was drawn to the absorption of the Spitalfields Mathematical Society (founded in 1717) by the R.A.S. in 1845. Many valuable mathematical books were thus added to the Society's library.

In 1835 the Society was given rooms in Somerset House, where it remained till 1874, when the present rooms were occupied. Grateful allusion was made to the long and faithful services of two Assistant Secretaries: Mr. John Williams (author of the well-known work on Chinese Comets), and Mr. W. H. Wesley, who had held the office for forty-seven years, and whose absence through illness they all deplored.

In conclusion, he referred to the granting of the new Charter in 1915, permitting the election of women as Fellows of the Society. Already the number of women who had been elected Fellows approached thirty.

Professor Turner then gave a biographical address, illustrated by lantern slides, on Fellows and Associates of the Society. The first slide was one of Queen Victoria, who had been their Royal Patron for two-thirds of their existence. It was noted that Kings of Denmark and Siam had been Honorary Members of the Society. The slides included portraits of Sir William Herschel, their first effective President, of his son, afterwards Sir John Herschel, who delivered a valuable opening address, and of Caroline Herschel. Portraits were also shown (among others) of Daniel Moore, Stephen Groombridge, Francis Baily, their first Secretary, H. T. Colebrooke, Dr. Pearson, J. C. Adams, Richard Taylor (Editor and Printer of the *Monthly Notices*, and founder of the firm of Taylor and Francis), Joseph Middleton, of the Spitalfields Mathematical Society, Sir George Airy, William Lassell and his Reflector, Dr. Common with his 5-feet Reflector, Professor Keeler, who used it in America, Sir G. Darwin, S. C. Chandler, Sir W. Huggins, Dr. F. McClean, J. Nasmyth, Warren De la Rue, Sir R. Ball, Professor Pritchard, W. F. Denning, Dr. Anderson, H. S. Perigal, Lord Lindsay, better known as Lord Crawford, who started Sir David Gill in his astronomical career, and Sir W. Christie.

The last slide shown was of a school football team including Professor Turner and Lord Haig in their school days; the inclusion of the portrait of the latter was justified by the suggestion that without his aid they might not be keeping their Centenary Celebration even two years late.

Professor Aitken then temporarily occupied the Chair, and gave a short account of the conditions of the award of the Bruce gold medal. He said that candidates must be recommended, on impartial grounds, by the directors of six of the leading Observatories of the world. This year the choice had fallen on the Astronomer Royal of England, Sir Frank Dyson, to whom he was empowered to give the medal at that meeting, which he proceeded to do.

At the conclusion of the Meeting, Members present were photographed in the Court of Burlington House (Plate 11).

The afternoon Meeting opened at 2.30, Professor Eddington, President, in the Chair. The proceedings commenced with the reading by the Secretary of the minutes of the inaugural Meeting, held on 1820 January 12, at the Freemason's Tavern, Great Queen Street, Lincoln's Inn Fields. Mr. Daniel Moore was elected Chairman, Mr F. Baily, Secretary, and John Herschel was among those present, all of whom signed an undertaking to support the formation of an Astronomical Society. The first Meeting of the newly-formed Society was held a month later, at the rooms of the Geological Society, Bedford Street, Covent Garden.

The President then called upon six Foreign Associates to speak on the work on which they were engaged.

Dr. Seares spoke on the photographic study of colour-indices that was in progress at Mt. Wilson; the method consisted in finding the exposure ratio for similar images in different regions of the spectrum. The result emerged that in stars of the same spectral type the dwarfs are redder than the giants; this holds more strongly for the types from F5 to M. This may be expressed by saying that the colour-index is a function both of type and of absolute magnitude. It appears that in the galaxy the opposite holds, the brighter stars being redder. The distribution of absolute magnitudes is therefore a function of galactic latitude. Among the extra-galactic stars a large number had been identified as dwarfs.

Professor Strömgren spoke on the studies concerning the problem of Three Bodies which were being carried on at Copenhagen. The method followed was that used by Sir George Darwin in his studies of periodic orbits, and consisted in the numerical calculation by mechanical quadratures of various assumed cases. In the early work on the problem the third mass was usually taken to be infinitesimal, so that the other two bodies moved in undisturbed Keplerian orbits; but they were now commencing the attack on the general case, where all three masses are finite. Going back, however, to the first case, it might be subdivided into the following classes:—

(1) Third Body moving in a direct orbit about one of the Masses.
(2) Third Body moving in a retrograde orbit about one of the Masses.
(3) Third Body moving in an orbit about both of the Masses.
(4) Third Body moving in a librational orbit about an equilibrium point.

Cases 1 and 2 could each be further subdivided into two, according as the third body went round the principal or the secondary mass; case 4 was that of the Trojan group of minor planets. Examples of all these cases were being worked out numerically; some of them had already been published.

Professor Harlow Shapley spoke on the method he was now carrying out of deducing the absolute magnitudes of stars from the series of spectral plates taken with Objective-Prism Spectrographs at Mt. Wilson and at Harvard. It was possible to deduce results in a much more wholesale manner from these than from the large-scale spectra employed by Professor Adams for the purpose, but of course the probable error was larger, owing to the small size of the spectra. The region of the spectrum that they principally employed was the cyanogen band, which they found to be stronger in dwarfs than in giants. Together with this work they were also examining star photographs taken at an interval of several years, for the detection of stars with sensible proper motions, which in most cases proved to be dwarfs with considerable parallaxes.

They were also studying the distribution of stars of different spectral types in various regions of the sky. They found that the brighter stars of type B grouped themselves along Gould's belt, which is inclined several degrees to the galactic equator; on the other hand the faint B stars grouped themselves along the galactic equator. The conclusion is that there is a local cluster containing the sun, the equator of the cluster being somewhat inclined to the galactic equator.

Practically no B stars are found above galactic latitude 30°. By finding the average number of stars of each type per unit of area, and then subtracting this number from that in the galactic zone, they found the galactic excess; in this way it was deduced that the B stars are all in or near the galaxy, that the A stars also show a large peak there, and the K stars a small peak, while the other types show practically no galactic excess. He also mentioned that Professor Baily had gone to Arequipa, and that one of his chief fields of work there would be the Magellanic Clouds. They had lately found some Cepheids of short period in the greater cloud analogous to those found in the globular clusters. Their apparent magnitudes accorded well with the adopted distances of the cloud and of the clusters.

He also alluded to an investigation of the relative speed of blue and yellow light by simultaneous photographs of the variables in certain globular clusters taken with plates sensitised for light of different colours. The results gave the maximum possible difference in the speed (assuming that his adopted distances of the clusters were correct) as one part in ten thousand millions.

Professor Hertzsprung spoke on the photometric work on certain variables on which he had been engaged while at Potsdam. The star RR Lyræ has a period of thirteen hours, but from differences in the successive cycles he had deduced that there was also a longer period of forty days, or 71·64 times the length of the short period. RR Lyræ was interesting since it was a short-period Cepheid, apparently of the same type as the cluster variables. It appeared to have three different periodicities, one of a few hours, one of forty days, and one of several years. There were

several other stars whose light-curve seemed to exhibit slow secular changes, not always in the same direction. δ Cephei was being investigated, in the endeavour to establish beyond doubt the secular change of period.

Professor Aitken spoke on Double-Star observation. He had in hand the study of the distribution of double-stars over the sky. Burnham's survey, splendid as it was, was not exhaustive. His own survey extended to all stars within 130° of the North Pole, and not fainter than the ninth magnitude, there being also a convention of distance between components, depending on magnitude, beyond which a star should not be classified as double. In the course of the work some three thousand new doubles had been discovered, of which some 15 per cent. already exhibited orbital motion. The theoretical researches included the causes of duplicity, the explanation of the wide gap between spectroscopic and visual binaries, and the correlation of duplicity with absolute magnitude. He noted that Mr. Innes had undertaken the region south of 130° N.P.D., indeed he went a little further north, so as to have an overlap with the northern.

Professor St. John said they had been testing Mr. Evershed's announcement that the spectrum of Venus showed an apparent Earth-effect, producing a displacement of lines towards the red. Their conclusion was that the effect was probably due to the different altitude of the planet at different stages in the synodic period; differential refraction between the visual and photographic image on the slit would explain it. Their Venus spectrograms had such a high dispersion that the planetary and telluric lines were widely separated by the Doppler effect. They were surprised to find a complete absence of the lines of oxygen and water vapour from the planet's spectrum; they had calculated that a metre of oxygen or a few millimetres of water vapour at atmospheric pressure would have given a visible effect. They were investigating the Venus spectra with a view to determining the rotation period. At present he would only say that he did not think that it was less than fifteen days.

He then described the repetition of the Michelson-Morley experiment. The platform was constructed of concrete reinforced by copper, which was chosen as being non-magnetic; a certain amount of shift was detected in the velocity of the beam, but it was only 8 or 10 per cent. of the amount calculated on the assumption that the experiment should show motion through the ether.

Going on to speak of the search for the shift in the solar spectral lines predicted by Einstein, he said that the cyanogen bands were unsuited for this problem, owing to their liability to temperature effect. A general study of lines in all parts of the spectrum was now being made; he could state that if the Einstein effect was present it was partially veiled by some other agency; a shift towards the red is shown, but the amount is not proportional to the wave-length. The research is being made both with the grating and the interferometer. He gave for the measured shift in the red region one-third of the Einstein amount; the strong lines in the violet agreed with this figure, but the weak ones gave twice the Einstein shift. They had made some

measures of the interval between the magnesium lines at 4481 which exactly confirmed those of Professor Fowler.

(*Note.*—The above brief summaries of the six speeches are admittedly incomplete, but it is hoped that they do not seriously misrepresent the speakers' meaning. They have not been submitted to them for correction, as this would have caused serious delay in the appearance of the Number.)

The Society dined in the evening at the Criterion Restaurant. Most of the Fellows and Associates who were present at the morning Meeting (see list accompanying Plate 11) were at the dinner, many of them accompanied by their wives or by friends. The following were invited as guests of the Society :—The Earl of Balfour, Sir J. J. Thomson, Sir W. Bragg, Sir E. E. Rutherford, Professor Seward (President of the Geological Society), Admiral Learmonth (H.M. Hydrographer), Professor Richmond (President of the London Mathematical Society), Dr. Chree (President of the Royal Meteorological Society), Dr. Russell (President of the Physical Society), Sir T. Petavel (Director of the National Physical Laboratory), Dr. Simpson (Director of the Meteorological Office), and Major Hepburn (President of the British Astronomical Association).

After the toasts of the King and the Royal Family, the Earl of Balfour proposed the toast of the Royal Astronomical Society in the following speech, the report of which is taken from the *Morning Post* of May 31.

He said they were just 100 years old, or, if he was to speak with astronomical accuracy, 102 years old. If the founders of that institution could have foreseen the progress of their beloved science some of them would have had certain misgivings. He believed that their first President resigned quite early because he was afraid that the Society would trespass on the ground reserved for the great Royal Society. That man misunderstood both the work of that Society and the unshakable position which the Royal Society possessed in the leadership of Science in the British Empire. None of those evil prognostications had come true.

When the relatively small body of astronomers met together to found that Society he supposed that, on the whole, what they looked forward to was that in the next 100 years increased accuracy of observation, and perhaps improved instruments, would enable them to refine and bring to a great perfection what might broadly be called the Newtonian scheme of the heavenly architecture. They certainly never foresaw that beyond the purely mechanical view of the heavens, beyond the field of mere improvement in precision and accuracy of instruments, there was going to be a whole new field of scientific speculation opened in all directions by the growth of physics, optics, and of the collateral sciences, which together enabled us to understand somewhat better the vast and glorious mystery which surrounded us, and which we saw every night.

The work astronomers had done in that hundred years was marvellous, and he rejoiced to think that on an occasion like that men interested in this particular science had come together in this disturbed world and were able to forget, round that table, discussing

those mysteries, at all events for a short time, the troublous period in which we lived.

After all, the bonds of science which united some of the highest spirits in all nations were untouched and unaffected by those painful, agonising struggles from which as men they could not escape, but which as scientific observers they were permitted for a time to forget. He welcomed the presence of men there of every nationality. He particularly welcomed their American friends from every point of view—as belonging to the great English-speaking community of nations, as fellow-workers in the great international labours of science, and as the possessors of the greatest observatories in the world; men who had not merely been able to build great observatories, but to use them to the best advantage.

He should imagine that the first English-speaking astronomer of eminence was that wonderful genius who died at an age at which in these days undergraduates had very often not taken their degree, but nevertheless he had left his mark on the history of astronomy—Horrocks. Of Horrocks it was said that by the aid of rudest machinery he calculated for the first time the transit of Venus. He was a clergyman, and the transit of Venus took place on a Sunday. He could only find time to see whether his calculations were correct if it should so happen that the transit took place in a clear sky between the religious services he was bound to conduct. Heaven was kind to him: the sky was clear; the transit took place as he had foreseen, and he had the happiness of looking at it through a telescope which cost him half-a-crown. How happy were his friends from America!

Horrocks was born just about the time the *Mayflower* started on its trip, and on the Continent which the *Mayflower* brought within the orbit of civilisation the successors of Horrocks had spent more than half-crowns upon American institutions they so admirably controlled. They did not love science better than we did, but had a happier climate for observation.

As they were celebrating the first hundred years of the existence of that Society, so they could look forward to the next hundred years, and if in that time a proportionate advance was made that Society would be able to look back triumphantly on a great and glorious past.

The President and Professor St. John replied. Col. E. H. Grove-Hills proposed the toast of "The Guests," to which Sir J. J. Thomson and Professor Seward responded.

On the afternoon of Wednesday, May 31, the Fellows and Associates were invited to the Meeting of the British Astronomical Association at Sion College. The proceedings are reported in the *Journal* of the Association for May.

On Saturday afternoon, June 3, the Fellows and Associates were invited by the Astronomer Royal to the Royal Observatory, Greenwich, on the occasion of the annual visitation of the Observatory.